FOUNDRY TRADE JOURNAL
Established 1902
WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL

Vol. 72 Thursday, March 30, 1944 No. 1441

The Foreman and the Future

There seems to be too little realisation among foundry executives that in the post-war era, the young people's colleges, which are to be established, will largely, but not entirely, replace evening classes in so far as the teaching of trade subjects is concerned. Immediately this is considered there arises the obvious question of staffing these schools with suitable teachers, and the only solution we can envisage is the wholesale release by industry of men on a part-time basis for teaching. Concurrently with the solution of this problem is a second one, of a more difficult character. We learn from those best qualified to know—an assembly of educational experts, industrialists, trade union leaders, and teachers—that for a variety of reasons it must be expected for a few years more, quite a percentage of the entrants to the young people's colleges will not possess the necessary educational background to absorb the instruction given. Thus it will be necessary by some means to repair this deficiency.

In a Paper from Mr. Douglas Jepson, who is well qualified to deal with the subject of post-war education, stress is laid upon the necessity for the works to continue to dole out the social benefits now undertaken and in future to be amplified by the school authorities, meals, medical and dental services, physical training and adequate clothing. These are both desirable and laudable, providing that throughout the whole training period, serious efforts are made to inculcate into the juvenile mind that the Yorkshire adage—"Owt for nowt is not worth having"—is untenable and that appreciation should be shown. Moreover, most of the services given should revert—when a better standard of living and higher level of culture have been nationally established—to the place where they belong, which is obviously the home. Parents have the undoubted right to demand that schools and workshops should be as sanitary, in the widest interpretation of the word, as the modern science of "good house-keeping" can create. It is acknowledged that slothful people can quickly turn good houses or flats into slums; so, too, a poor management can reduce excellent shops into their industrial equivalent.

Usually, the duty devolves upon the foreman to see to it that his department is adequately maintained. This duty is more arduous for the foundry, especially when making iron castings, than for the rest of the works. In the post-war era, no more must be heard of the twin excuses for untidiness, the inability to afford the cost of the necessary labour or the too-pressing needs for production. Good house-keeping must be a prior charge. The war has placed too much emphasis on the foreman's duty as a teacher; and an article by Mr. E. Watson Smyth, the principal assistant and secretary of the Training Department of the Ministry of Labour and National Service, in "Production and Engineering Production," typifies this. He defines the foreman's duties as a manager, a supervisor and a teacher. In the first capacity he is expected to plan, execute and correct work; in the second to check the execution of his plans and to find the causes of any failures; and in the third to train new workers for new jobs and old workers in the better performance of old jobs and in new ways of doing them. To this very incomplete listing of the foreman's duties we take objection to the inclusion of the training of new workers (and in training one must presume the inclusion of the youthful entrant), because of the false premise that because a man has risen to the position of a foreman he must, *per se*, be a heaven sent teacher. A few are, but the really high-grade foreman is the one who can select a man or men for this job just as he chooses others to be charge hands, to undertake experimental and development work, to go outside on erection jobs, and generally to place square pegs in square holes.

Thus, in this post-war era, it will be a foreman's job to supply for both internal and external craft training, many hundreds of skilled men possessing

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NOTES FROM THE BRANCHES

London Branch, East Anglian Section.—There is to be a visit to the works of Crane, Limited, on Thursday, April 20, at 3 p.m. A few members of the parent Branch living beyond the East Anglian area can be included. Those interested should write to the hon. secretary of the Branch, not the Section. The works visit will be followed by the annual general meeting, to be held in the Central Library, Northgate Street, Ipswich, at 6.45 p.m. The session will conclude with a discussion on the Report of the Non-Ferrous Sub-Committee's Report on "Defects," which will be presented by Mr. J. E. Newson, of the Manganese Bronze & Brass Company, Limited.

Lancashire.—A meeting was held on March 4 at the Engineers' Club, Manchester, under the chairmanship of the Branch-President, Mr. E. J. L. HOWARD. There was a large attendance of members and visitors. In opening the proceedings, Mr. Howard said that eight short Papers had been received from members of the Lancashire branch, not one of whom had previously presented a Paper before any Branch of the Institute. A time limit of 20 minutes had been arranged for the delivery of each of the Papers, and at the conclusion of their reading the members would be invited to record their votes by ballot for the first and second best communications. The first prize would be either one of books or instruments to the value of three guineas and for the second best Paper 1½ guineas.

The following Papers were then read:—(1) "Dry Sand Rammed Up Cores," by Mr. J. Bedford; (2) "Some Methods of Utilising Atmospheric Pressure in Cast Iron," by Mr. W. Collinge (this Paper was written while the Author was *en route* to India, and, in his absence, was read by Mr. W. Holland); (3) "The Education of the Foundry Apprentice," by Mr. A. Davidson; (4) "The Jobbing Ironfoundry," by Mr. F. Gater; (5) "Some Thoughts on the Ironfoundry of the Future," by Mr. G. M. Priestley; (6) "Ingot Mould Making," by Mr. J. G. Rees (read in the absence of the Author by Mr. F. A. Harper); (7) "Description of Core Setting Jig," by Mr. R. S. Turner; and (8) "Post-War Reconstruction," by Mr. E. R. Waddington.

Mr. G. C. Studley (Manchester), and Mr. S. Brooks (Manchester) were appointed scrutineers of the ballot papers. Mr. G. M. Priestley was awarded the first prize, and Mr. A. Davidson second prize.

The BRANCH-PRESIDENT wished personally to thank all the Authors of the Papers for the very good work they had done. Most of the Papers read could have been considerably extended into the compass of a full lecture. MR. J. HOGG (Burnley) proposed that a vote of thanks be accorded to the Authors for their extremely interesting communications. They had all expressed their views in a particularly clear and practical manner which, in his opinion, has not been surpassed by recorded Papers in the past.

MR. H. HAYNES (Ashton-under-Lyne) seconded the vote of thanks. In his opinion, really each one of the Papers deserved a prize, and they certainly merited the prize of appreciation. He hoped the Branch would enjoy similar sessions in the years to come, because such an interchange of ideas was definitely invaluable. Personally, he was particularly interested in the education of the foundry apprentice, and had on occasions given youths of 19 years of age jobs of casting costing £200 to £300, and which they had carried out with remarkable efficiency. These youths were fully aware of the heavy responsibility involved, and completely demonstrated their ability to undertake the work in a thoroughly workmanlike manner.

East Midlands.—The February meeting was held at the Derby Technical College, Mr. W. H. Smith presiding. It was devoted to a discussion of the non-ferrous Committee's notes assembled under the title of "An Atlas of Defects in Non-Ferrous Castings." It was presented on behalf of the committee by Mr. F. Dunleavy, and was adversely criticised by Mr. H. Bunting on the grounds of insufficient details being attached to the illustrations. Mr. Gardom pointed out that the object sought was one of nomenclature and not a full diagnosis of defects. Mr. P. A. Russell thought the committee had failed adequately to differentiate between shrinkage cavities and contraction cracks. Most speakers were satisfied that the committee had done good spade work, and that there was a reasonable prospect of good progress being made. Mr. Dunleavy was thanked by the meeting on a proposal made by Mr. F. Butters, and seconded by Mr. W. Niven.

THE FOREMAN AND THE FUTURE

(*Continued from previous page.*)

a natural aptitude for teaching. Moreover, there must be made a mental differentiation between wartime training designed to make an operative competent to do one job and post-war teaching calculated to create a sustained interest in a trade. This country will prosper, when the mentality of youth, both male and female, has been changed from a desire to be a machine minder to an urge to become a real craftsman, or an executive. If the future make-up of industry be such that there is but little room for the craftsman, then the inherent desire to do original work latent in so many people must be developed by the encouragement of manual hobbies, and we understand that this objective is to be fostered in the young people's colleges. From the above, it should be clear that the industries which will receive the major benefits from the new educational system are those which by co-operation will orient the work of the young people's colleges into channels cut so as to align themselves with that industry's planned objectives. In this, as is usual, it will find expression through the intelligent and enthusiastic co-operation of the foremen.

SLIP COATED SYNTHETIC FOUNDRY SAND

A Ceramist's views on foundry sand problems

By FELIX SINGER, Dr.-Ing., Dr.phil., M.I.Chem.E.,
Consulting Ceramist

The war and its ever-increasing output requirements have greatly speeded up the growing pre-war tendency to re-bond used natural foundry sand and to rely for very many purposes on fully synthetic foundry sand. This modern trend is most pronounced in the three main industrial belligerent countries—Britain,[1] the United States and Germany.[2] The situation has been well summarised by Norman J. Dunbeck[3] in a Paper in which he enumerates the following advantages of synthetic foundry sand:—(1) Perfect control of all properties less scrap; (2) absence of silt; (3) uniformity; (4) high flowability and high permeability; (5) better refractoriness; (6) savings in material, haulage and storage; and (7) longer life.

The question of sand supplies presents no great problem. Graded silica sand as used for this purpose in most industrial countries is available in quantities. In certain countries a tendency is noticeable to replace silica sand by other graded rocks in order to prevent silicosis.[4]

The question of the clay bond for the graded sand presents no difficulty in the United States; that country has extensive deposits of the binder, *par excellence*, bentonite, in twelve of the States, the production amounting to over 350,000 short tons in 1941.[5] The situation in Britain is quite different, as there are no deposits of true bentonite, and the country has to rely on imports.[6]

Considering that the bonding of sand is, in many ways, closely related to certain ceramic practices, it was thought that a ceramist's accumulated knowledge of the properties of clays might be helpful in elucidating some of the foundryman's problems, and the author began some time ago experiments intended to approach, from a clay-worker's point of view, the problem of finding a United Kingdom bonding material capable of replacing imported bentonite without impairing the quality of the synthetic foundry sand. However, before he had got very far, the Second Report of the Moulding Materials Sub-Committee of the Steel Casting Research Committee was published (November, 1942),[7] which describes some very acceptable solutions of the problems of substituting imported bentonite by English materials, *viz.*, Fulbond, Colbond, Distribond and Fuller's earth.

Experimental Observations

He therefore abandoned a part of his experiments, but wished to report, nevertheless, on a few experimental observations which it is thought throw an interesting sidelight on certain phenomena which may have puzzled practical men as well as theoretical investigators.

The initial angle of approach was that the enormous variation of the actual sand surface with the grading of the sand has not, so far, been fully appreciated in practice. Not only is the permeability of the moulds largely dependent on this grading, but the strength of the moulds must obviously depend on the actual sand surface area, which a given proportion of bond is to cover. Furthermore, any crushing of the sand particles during the mixing operation is likely to mask the results.

It was therefore considered necessary to effect the covering of each sand particle with a film of clay by a pure mixing operation, not involving any crushing or grinding action which would increase the total sand surface and consequently the total quantity of bonding material required, and, in addition, would generally influence the permeability of the finished mould. For these reasons the Beken Duplex mixer was chosen, as previous experiments had indicated its entire suitability. As the machine differs widely from mixing machines commonly used in foundries, a short description of the machine and its action may be of interest. The mixer is of the two horizontal shaft type and, as is usual with this type of machine, the bottom of the pan is formed in two sweeps; within these sweeps revolve paddles carried on the two horizontal shafts. The paddles and their action differ widely from those in the conventional types of horizontal shaft mixers, as they are of an unusual design which permits such close intermeshing or overlapping of the paddles on one shaft with those on the other shaft that the tips of one set of paddles only just clear the bosses of the opposing set of paddles. In spite of this intermeshing one set of paddles revolves at twice the speed of the other set. The paddles sweep the bottom and sides of the pan clear of material, so that at each complete revolution all the ingredients are lifted from the bottom and squeezed and kneaded between the paddles. Thus all the mixing work is done between the paddles and not between the paddles and the pan. The result is a continual movement of the sand grains over each other whilst under some degree of pressure, an ideal method of coating the grain surfaces without destroying grain sizes.

Fig. 1 shows a complete cycle of the paddles, and demonstrates their positive action in the mixing process. The paddle illustrated on the left revolves twice as fast as the paddle on the right. Each paddle illustrated has two blades, and these are numbered 1, 2, 3 and 4 in the illustrations.

In operation both paddles would be surrounded by the material being mixed. The faster moving blades do not quite overtake the slower ones, but, just before

Slip Coated Synthetic Foundry Sand

contact, a position is reached where the outer edges of the faster blades scrape the flat surfaces of the slower blades and remove any material that might be adhering to them. It will be seen that in a quarter revolution of the slower blades the faster moving set has completed half a revolution. At this point the least distance between the blades is reached. During the second half of the revolution the faster blades pass in advance of the slower blades, the material ceases to be squeezed and is "opened out" or "drawn out," the mixing operation is therefore positive. The whole of the wetted graded non-plastic material, the mixing to be continued until (theoretically) the plastic clay has achieved such a division that each particle of non-plastic graded material is covered by a thin film of plastic binding clay; and (3) as a watery suspension, to be mixed with the graded non-plastic dry or humid material, the mixing to be continued until this liquid suspension has covered all non-plastic graded particles.

A water clay suspension can be made by blunging clay purely mechanically in enough water to produce a liquid slurry or by blunging clay in water, adding at the same time suitable alkalies, thereby producing a cream-like colloidal so-called "clay casting slip."

Dry Clay.—To introduce the clay in the form of

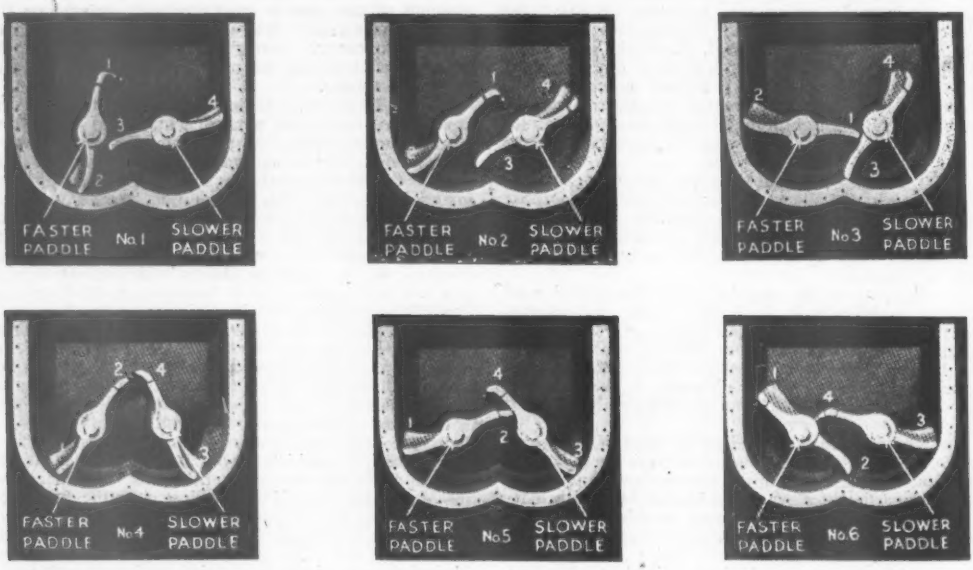

FIG. 1.—MIXING MOVEMENTS IN THE BEKEN MACHINE.

charge passes in turn between the blades, producing an intimate mix in a minimum of time.

States of Clay for Use

As a clayworker, the author is accustomed to employ clay not only as a main ceramic material, but also as a binder for non-plastic materials, *e.g.*, as a binder for refractory grog. It is common practice to use for this purpose clay in one of the following states:—(1) As a dry powder to be mixed with the dry grained non-plastic material. After this first dry mixing, water is added and the mixing continued by kneading until the greatest homogeneity is achieved; (2) in a plastic condition, to be kneaded and mixed with the dry or a dry powder has the advantage that both dry clay powder and non-plastic graded materials can easily be mixed, and that a fairly high degree of homogeneity is reached before the water is added, provided that the clay is ground to a great fineness and that no further crushing of the non-plastic material takes place. The disadvantage of this method is, first of all, the necessity of drying the clay carefully, and of grinding it separately to a very fine powder. But even if it is ground to the greatest commercially feasible fineness, it could never be fine enough to produce by a short mixing operation with sand and water, a film thin enough to cover the total surface of each particle of sand, thereby really "binding" the sand to a homo-

geneous mass; therefore the mixing would have to be continued to effect further sub-division until the non-plastic material is covered by a thin film of binder. Considering the toughness of the plastic clay this consumes mixing time and power.

Plastic Clay.—The method of introducing clay in the plastic state[10] would have the advantage that no special machinery for the clay preparation, for example, for dry clay grinding, would be necessary. It would be sufficient to soak suitable clay in the state of its arrival from the pit for a week or a few weeks in water.

It would be easy to test such plastic clay, in each special case, before using it in the mixing machine. The mixing would have to be continued until the sand particles have been completely covered with a clay film. The disadvantage of this method would again be the toughness of the plastic clay and the difficulty or impossibility to attain the quick sub-division which would ensure a very thin clay film being produced to cover all non-plastic sand particles without adding more water than is permissible in synthetic foundry sand.

FIGS. 2-4 SHOW THE STAGES IN THE COVERING OF SAND GRAINS BY BOND.

Watery Suspension

The difficulties of covering each grain of non-plastic material with a finely divided film of clay can easily be overcome if the clay is first transformed into a state in which the development of very thin films does not offer the same resistance as it does in the tough plastic state. This is the case if the clay is introduced as a watery suspension. Theoretically, two methods are possible for this purpose, but the watery suspension of clay without the addition of any deflocculant electrolytes needs a large proportion of water. If the whole quantity of clay required to make synthetic foundry sand were introduced in the form of a watery clay suspension, the permissible limit for the water content would be greatly exceeded. If, however, the clay is first converted into a colloidal casting slip by the addition of the most suitable deflocculants, the proportion of water necessary for this purpose is low enough to yield fairly dry synthetic foundry sand.

Conversion of Clay

The conversion of clay into a colloidal casting slip for ceramic purposes normally involves a special operation, such as blunging the mined clay or grinding the previously dried clay, followed by blunging it with the most suitable chemicals. In addition an adjustment of the chemical additions for each clay and for each factory water is a necessity. This seems to be complicated, but it has to be done only once, all repetitions being routine work, and the advantages of this ceramic method are very great indeed. In reality this method has proved a most successful process for refractory purposes.

In the case of synthetic sand bonding, the separate preparation of clay slips and even the careful adjustment to obtain full liquefaction with the minimum proportion of water are, however, unnecessary, which simplifies matters very much.

The use of a Beken Duplex mixer enabled the author to re-examine the question of the effect of the mixing time on the green strength of the sand. Using the mixer at a very low speed, and testing the mixture of sand, clay and water repeatedly for green strength by the A.F.A. method, he obtained a slow-motion picture of the gradual coating of the sand granules with the clay bond. As a result, it was found that the maximum coating effect, which corresponds to the maximum strength, required a very thorough mixing

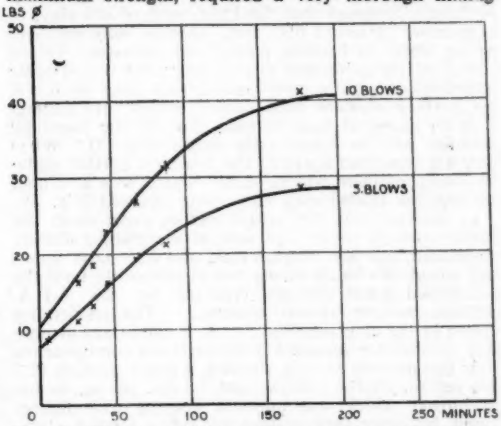

FIG. 5.—EFFECT OF MIXING TIME ON GREEN STRENGTH.

in the *wet* state. The dry mixing of sand and powdered clay, although a very useful preliminary step, cannot possibly produce the complete coating which is essential to obtain the highest bonding effect for any given proportion and water content of the clay bond employed.

A short calculation will explain this:—The sand employed was an average type of silica sand graded as follows:—

5	10	16	30	44	60	85	100	120	150	200
0	0	0	2	8	28	36	12	8	2	0

Assuming that the granules were all spherical and had a specific gravity of 2.65, there is a surface area of 99.4 sq. cms. per gramme of sand. If it is further assumed that the specific gravity of the dry clay is 2.6, it is found that a complete covering of the surface of the sand by a film of clay would only allow for a film thickness of as little as 3.8μ, or $\frac{1}{6,700}$ in.

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There is no doubt at all that dry milling cannot break up clay to a particle size of this order of magnitude. If the very favourable assumption is made that the usual dry-milling operation breaks the clay into minute lumps passing through a 44-mesh sieve, aperture 0.353 mm., the averagable little lump would still contain $\frac{353^3}{3.8} = 800{,}000$ particles of the maximum size as worked out above.

Coating Operation

Therefore, the actual coating operation must necessarily be of a physico-chemical nature, in which the more or less colloidal dispersion of the clay in the tempering water is the decisive phenomenon. Let it be further assumed that the little lump of dry clay, of a diameter of about 0.35 mm., absorbs sufficient tempering water to become plastic and adhesive. In the course of the continued mixing operation it will come into contact with a sand granule and stick to it. If the surface element thus coated comes into contact with an uncoated sand granule (Fig. 2), the two sand granules will be temporarily linked (Fig. 3). When they are separated again in the course of further agitation, each of them will be partly coated with a thinner coating, the coated area now being doubled (Fig. 4).

In carrying out the actual mixing experiment, the author used 10 parts silica sand of the grading already mentioned, one part English clay, and 0.35 parts water, and mixed this batch slowly and continuously until the ascertained green strength repeated by the A.F.A. method, became almost constant. The results are shown in the diagram (Fig. 5). It is important to note that the mixture appeared to be perfectly homogeneous after five minutes mixing, showing a green strength (2.7 lbs. per sq. in. for 3 blows and 3.8 lbs. per sq. in for 10 blows), which was quite in keeping with figures found by other investigators for other English clays. The remarkable increase in green strength by another 240 per cent. obtained by continued mixing obviously suggests that the usual way of mixing sand and clay in pan mills or the like leaves scope for very considerable improvement.

The remarkable increase in green strength by effective mixing appears to be in contradiction with the finding of the Moulding Materials Sub-Committee[10] that the green strength scarcely increases after two minutes milling in a pan-mill[11], and that extra long milling (20 minutes) gives a mix which is no stronger than that prepared by ordinary milling.

It may be that these earlier results are due to the unique nature of the bentonite which was used in those experiments[12]. But the curves for 3 and for 9 blows in Fig. 1 of the Report are not so very dissimilar from the authors, and Knipp and Emde[13] investigating the influence of prolonged pan-milling of a mixture of washed sand with 12 per cent. clay and 4.8 per cent. water also find very substantial improvements in green strength and other practical properties (absence of flaws, smoothness of castings) by prolonged pan-milling for 20 or, better still, for 30 minutes. Plotting green strength versus milling time, these authors obtain a rather angular curve not so very dissimilar to the authors, with a maximum of almost 100 per cent. above the value for five minutes.

That the curves of Fig. 5 are much smoother is partly due to the much slower rate of mixing in the small laboratory mixer, and partly due to the fact that the mixer used was a mixing machine pure and simple, the efficiency of which was not reduced by the variation in the physical properties of the batch, its growing green strength, etc.

(To be continued.)

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[11] *Ibid.*, p. 18.

[12] *Ibid.*, p. 19.

[13] "Neue Wege der Formwirtschaft," Die Giesserei, Vol. 28 (1941), p. 488.

Optimum Silicon Content in Grey Iron and Chromium Iron

The optimum range of silicon content for resistance to growth and general deterioration at 800 deg. C. lies between 3.5 and 4.5 per cent. in plain grey iron and 0.5 per cent. lower in 2 per cent. chromium iron, according to MESSRS. BURGESS and BISHOP in a Paper given before a recent Convention held by the American Society for Metals. The 2 per cent. chromium iron maintains its as-cast strength even though the silicon reduces its hardness and increases machinability.

Low-hardness Anti-friction Cast Iron

A commercial process for the production of an anti-friction cast iron of pearlitic structure and with a low relative hardness value is described by N. I. FEIGIN in the Russian "Foundry Journal." The analysis of the iron is 3.4 to 3.7 per cent. C, 2.4 to 2.6 per cent. Si, 0.8 to 0.9 per cent. Mn, up to 0.25 per cent. P, 0.1 to 0.12 per cent. S, up to 0.35 per cent. Cr, and 0.36 per cent. Ni. The Brinell hardness is between 145 and 160. The micro-structure consists of medium graphite, pearlite, a fine phosphide eutectic and up to 10 per cent. ferrite.

QUALITY CONTROL IN HIGH DUTY IRON PRODUCTION

By E. W. HARDING
(The International Meehanite Metal Company, Limited)

Importance of ensuring constancy in casting performance

(*Continued from page* 242.)

Standard Chart Values

Average and Range—Tensile, Meehanite GC.—Values for centre lines are based on Meehanite standards. The control limits are calculated in the same way as already given, but in this case no correction for sample size is made, since the standard value represents the bulk characteristic. The chart line values for this example are:—

	Centre line (standard value).	Control limits.	
Average	19.00	Upper limit—20.26 Lower limit—17.74	= Average ± 1.26 times standard deviation.
Range ..	2.5	Upper limit—5.00. Lower limit—0.78.	

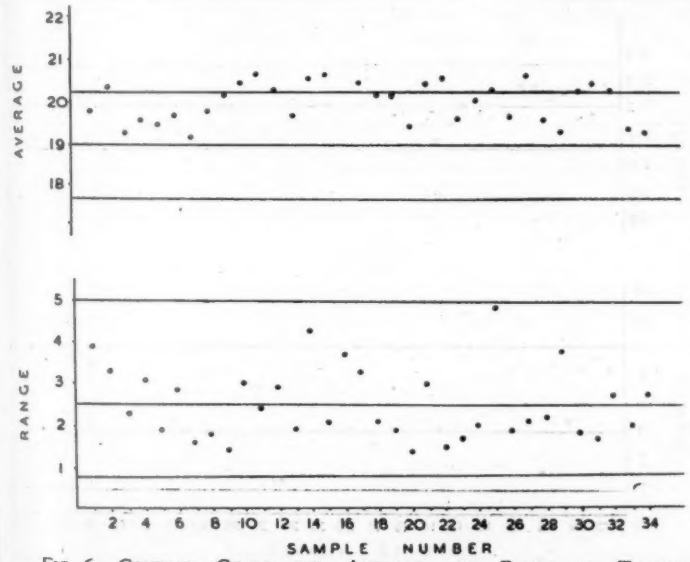

FIG. 6.—CONTROL CHART FOR AVERAGE AND RANGE OF TENSILE ON MEEHANITE "GC." MEEHANITE STANDARDS.

In Fig. 6 is shown an entirely different picture. The chart points for Average are now seriously outside the upper limit line, showing that a production process may record excellent results in regard to uniformity, but be far from satisfactory as regards magnitude of values. For this reason, in Meehanite practice the Standards charts are used in preference to the No-Standards charts.

Example 2.—One of the principal uses of the control chart is to provide early warning of a change in quality and thus enable corrective action to be applied *before* an actual breakdown in control has taken place. The example shown in Fig. 7 will illustrate this point. It is taken from test values of Total Carbon on Meehanite "GD" representing four months' working, before the charts were installed, and shows how a breakdown could have been averted by use of the chart. To save space the complete list of test values will be omitted, the essential data being provided by the plotted points for Average and Range. The Standards Chart only will be given, as sufficient to illustrate the point.

In interpreting these charts, it must be remembered that each plotted point represents, not an individual test result, but the average of six results. Consequently, an upward or downward movement of two or three of these points is indicative of a definite product change rather than an individual fluctuation. These movements, or trends, thus provide a warning of an impending change, and it is one of the most useful features of these charts that, by closely watching the position of each new plotted point and applying corrective action where necessary, changes in product quality may be averted.

If, for example, samples 6 to 11 are taken, they show a consistent downward trend, which is corrected just before the lower limit is reached. The recovery from Total Carbon downward trend is followed by a period of fairly uniform scatter around the central value. From the 20th sample, however, a second downward trend occurs which persists longer, until finally the limits are exceeded. It will be noted that corrective

Quality Control

action was applied, but too late to maintain product quality. In this particular case, the warning was given some three weeks before the breakdown finally occurred.

The position in regard to the Ranges chart is somewhat different from that for Averages. Here interest is centred on holding variation below the upper limit. While no fixed relation exists between the movements for the two charts, a change in values on the Averages Chart is usually accompanied by an increase in the Ranges value. For example, the upward trend in Ranges around samples 22-25 occurs at a time when the Average values are showing a downward trend, confirming that a change is taking place and that an assignable cause of trouble is present. Such a cause would probably be in the nature of a change in raw materials, and in this case the quality of new coke consignments would be suspected. Corrective action would then lie in adjusting coke charges and mix composition to the new conditions, so that the final level of values remains unaltered.

Example 3. — It sometimes happens that a gradual and imperceptible change takes place over a fairly long period, in the test values for the product. Such a change is difficult to detect from the test records, and may easily escape attention until the product has undergone a definite alteration and quality control breaks down. A case of this kind is shown in Fig. 8, taken from the test records for Silicon content in Meehanite "G.D." The test figures represent a period of three months' operation, and are plotted on the Standards Chart for Average and Range.

The persistent fall in the sample Average values is most striking when seen on the chart; yet from the tabulated list of individual test results no such

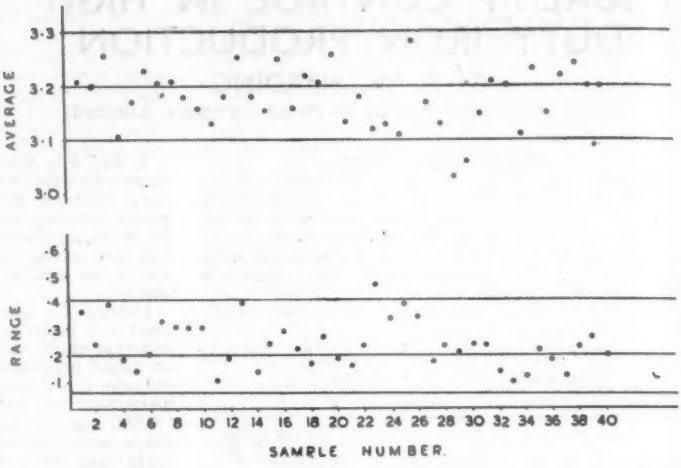

FIG. 7.—CONTROL CHART FOR AVERAGE AND RANGE OF TOTAL CARBON ON MEEHANITE "GD." STANDARDS CHART.

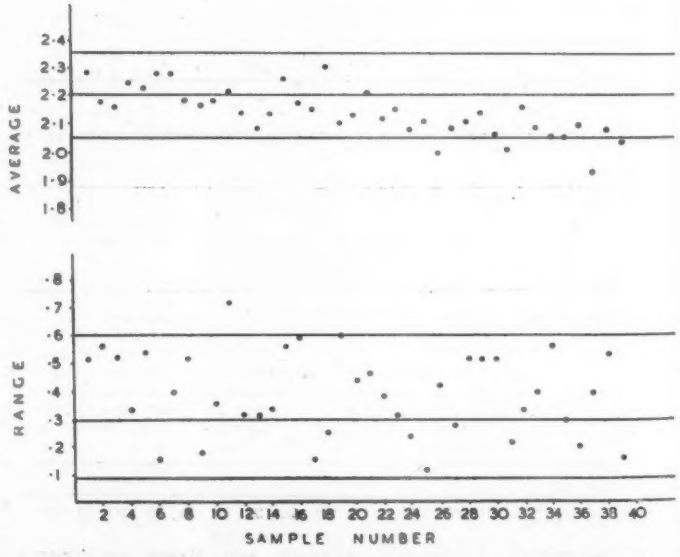

FIG. 8.—CONTROL CHART FOR AVERAGE AND RANGE OF SILICON ON MEEHANITE "GD." STANDARDS CHART.

trend is apparent. The value of visual evidence of the control position is clearly seen, particularly when the results are grouped and positive movements are examined rather than the confusion of individual results.

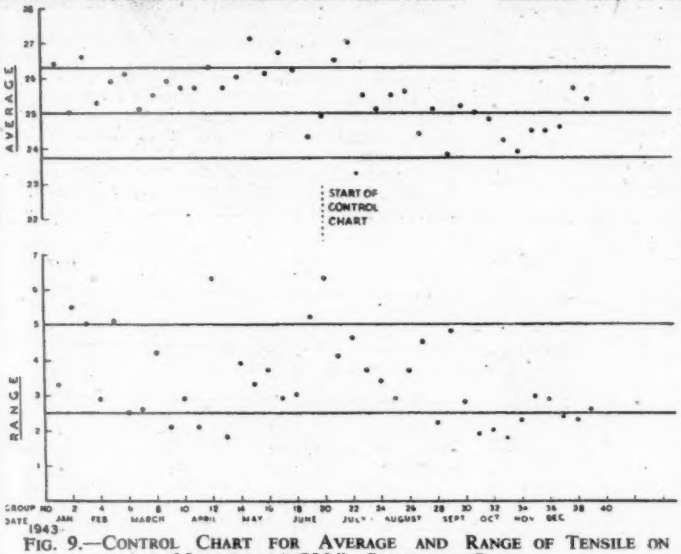

FIG. 9.—CONTROL CHART FOR AVERAGE AND RANGE OF TENSILE ON MEEHANITE "GM." STANDARDS CHART.

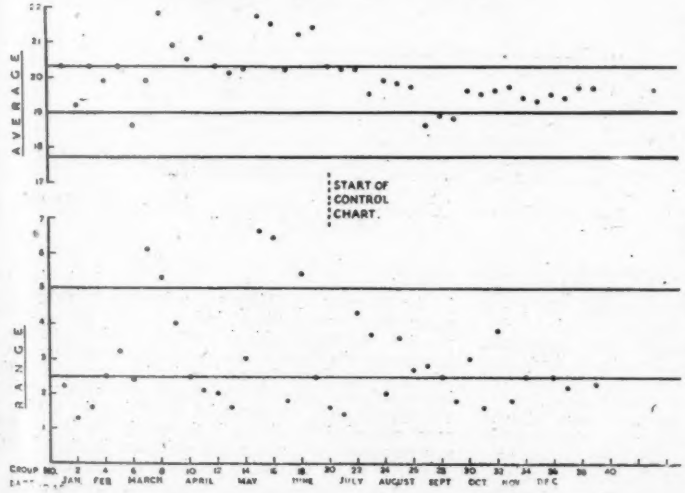

FIG. 10.—CONTROL CHART FOR AVERAGE AND RANGE OF TENSILE ON MEEHANITE "GC."

Change in Product Values

The situation in this case is one where the change in product values must be corrected or new standards must be adopted. In the former case, corrective action lies in holding standard calculated silicon contents of charges, particularly as affected by changes in raw materials. In the latter case, the new standards must be clearly specified in advance; for example, a changed type of work in the foundry might call for mix alteration, but, in this case, the chart must be adjusted to the new standard control lines. In this particular case, the foundry merely drifted into the new level of silicon content—a condition which could not have existed had these control charts been applied.

Example 4.—This example details in Fig. 9 a typical case of the improvement in metallurgical control obtained since the introduction of this system. It is only one case out of many, but it will illustrate the results now being obtained. The example is taken from the test records for the twelve months (January-December, 1943), for Tensile on Meehanite "GM." In this particular foundry the new system was started at the beginning of July (sample No. 20), and the comparison is given of the results obtained for the period before and after the installation of these control charts.

The improvement in the values for both Averages and Ranges will be evident. It is particularly striking in the case of Range values, where a rapid and consistent drop has been obtained, indicating a definitely greater degree of product uniformity than had been obtained in the period prior to the use of the chart system. Other examples are shown in Figs. 10 and 11.

General Interpretation

It may be asked how the mere introduction of charts could effect such an improvement. This will be dealt with later in relation to the interpretation of the charts, but it is worth noting that the metallurgists who use

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these charts report that their work has been greatly simplified, since they can now distinguish between *real* and *apparent* changes in quality. They are no longer confused by the continual individual fluctuations and concentrate on the relative positions of the group points for Average and Range. If these points are right, then the product is under control. If they are moving towards the limits, the metallurgist can make the necessary adjustments, in most cases even before the completion of the six tests results making up the simple sample.

It will be understood that these charts cannot of themselves correct a bad condition. Their function is to show up the true state of affairs and thereby lead to corrective action. They can be used not only to indicate a breakdown in control, but also to provide early warning of a change in quality.

The relation between the chart for Averages and that for Ranges must be clearly understood. The Averages chart records the approach of the product to standard property values, while the Ranges chart indicates the fluctuations which occur within the product. Both factors are obviously important, but the Ranges chart is more directly related to product consistency, and is a reflection of the performance of operator, plant and supervision.

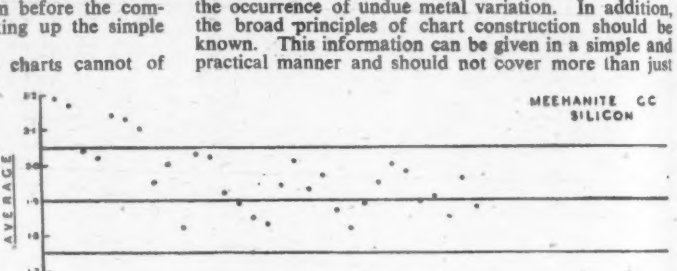

FIG. 11.—CONTROL CHART FOR AVERAGE AND RANGE OF SILICON ON MEEHANITE "GC."

Application

In applying these charts to metallurgical control it is advisable to start by taking one or two of the mixes of major importance, both in regard to quantity of output and quality of product. Two types of metal mix will usually be sufficient to represent the foundry output, particularly if these are produced daily and subjected to purchase specification control. In some foundries, one mix alone may be taken, where this forms the bulk of the output and the most important product. In all cases, it is preferable to keep the charted mixes to a maximum of three, to avoid obscuring the picture with too great a wealth of detail.

The test properties charted for each mix should similarly be held to the minimum for the same reason. These are best confined to Total Carbon, Silicon and Tensile. These test values charted for, say, two mixes, will represent only a small amount of work. In actual practice it will mean that approximately once a week the metallurgist will plot six points on each of two charts—the values for three points being the Average of six test results and those for the other three points being the Range of the results; that is, the difference between the maximum and the minimum of the six results. The whole time involved is normally about half an hour one day per week.

It is not to be expected that the foundry staff will in all cases be able fully to appreciate the theoretical principles on which this statistical treatment is based, nor is it necessary that they should attempt to do so. What is of primary practical importance is that the charts should be so used and interpreted as to prevent the occurrence of undue metal variation. In addition, the broad principles of chart construction should be known. This information can be given in a simple and practical manner and should not cover more than just a small number of typewritten sheets.

Furthermore, these charts should not be buried away in the laboratory. They are primarily of value to the management as a visual indication of the trends and progress of metallurgical control. They are also of interest to the foundry in correlating metal test values with casting properties and assist in running and risering problems. For all concerned, and particularly for the metallurgist, an essential condition in getting the most out of these charts is the ability to interpret the results accurately, and some guidance in this direction is given in the following section.

Detailed Interpretation of the Control Charts

To be of real practical value, these charts must be applied, and this requires close attention to the levels

and trends of plotted points and the ability to form correct conclusions as to the operating factors responsible. Some experience is needed to assist judgment in chart interpretation. An analysis of typical events is given below, together with the causes responsible, as a general guide to interpretation:—

First Event.—Averages within standard limits but Range values near or outside standard limits.

Cause.—Variation in test values tending to balance one another, due to periodicity of operating variables. Factors of a periodic nature should be checked, such as:—(*a*) Variations due to use of different cupolas on alternate days; (*b*) periodic changes in raw materials, especially at short intervals, *e.g.*, coke; (*c*) different operators at different times, *e.g.*, shift work; (*d*) tests taken at different parts of the heat (*e.g.*, beginning and end of heat) for the same mix.

The corrective treatment for the above type of event is to break down the data into rational sub-groups. For example, the test results are separated for each cupola and plotted on different charts. This may reveal a quite definite difference in the properties for the two sets of material, and thus explain the wide range. Similarly for the other possible sources of periodic variation given above. Once it has been established which of the causes is responsible, the corrective action to be applied will be obvious.

Second Event.—Average values show excessive variation while Ranges are within standard limits.

Cause.—Progressive and frequent upward and downward movements in test values are the main condition for this event. It represents a stage of rapidly changing trends, where the changes are progressive but irregular. Range values remain low because the fluctuations have a longer time cycle than the groups. The event occurs with such operating factors as:—(*a*) Changes in mix composition without adequate precautions against cumulative effect of altered composition of returns; (*b*) continuous changes in charge composition, through lack of mix adjustment to suit changing materials analysis; and (*c*) cumulative effect of changes in raw materials composition, *e.g.*, coke, ferro-alloys, etc.

An event of this nature is seldom encountered to any serious extent. The remedy lies in close check on individual results and group values so as to anticipate and correct off-standard tendencies before they become serious.

Third Event.—Both Average and Range values exceed standard limits—the fluctuations being of an irregular nature; that is, without definite upward or downward trend.

Cause.—This is a clear case of lack of metallurgical control. Two types of this event may be recognised:—(*a*) Where the level of control is below standard but no definite breakdown or change in control has taken place; and (*b*) where control has broken down from former levels and an assignable cause may be traced.

In the case of 3 (*a*), the operating causes responsible for the off-standard results may be any or all of the many variables incidental to melting practice—raw material control, bed preparation, charging practice, blast volume and velocity control, tapping practice, test-bar technique, etc. A check on these controls will often reveal one or two mainly responsible for the variations, but in some cases it is necessary to take each control point and correct it from first to last of the melting operations. In this way, the whole curve of test results is disturbed, resulting in a narrower range between the maximum and minimum values.

In the case of 3 (*b*) it is necessary to establish the particular operating cause or causes which have led to the breakdown in control from former levels. A number of clues are provided by the chart points in determining the cause and correcting this condition, such as:—

(1). Whether the breakdown occurred on all the mixes or is confined to one mix only. If on all mixes, look to control points common to the whole melt, *e.g.*, raw materials composition; charging practice; blast control, etc. If confined to one mix, check factors directly affecting that mix, *e.g.*, if mix is melted twice in heat, giving different properties; if varying position in heat is responsible for variation, etc.

(2). Whether the breakdown occurred for one property only or is common to T.C., Si, Mn. and Tensile. For:—

Carbon variation.—Look to coke quality, bed preparation, charging practice, steel quantity and quality, blast velocity.

Silicon variation.—Look to ferro-alloys and pig-iron composition, charging practice (for ferro-alloys especially), segregation of foundry returns.

Manganese variation.—Look to ferro-alloys and pig-iron composition, charging practice (for ferro-alloys especially), segregation of foundry returns.

Tensile variation.—Look to tensile bar casting practice and testing technique, check correlation with composition values.

If all these properties are affected by the breakdown in control, then the indication is that metallurgical supervision has become slack and needs tightening.

(3). Whether the breakdown coincides with plant or organisation changes, or changes in raw material suppliers or any other factor of a like nature which can be associated with the change in the level of control. A good practice in correlating operating conditions with the standard of control is to indicate on the chart (or on a separate sheet) any change which could contribute to product variation. If this is done at the time of its occurrence, then the task of tracing the cause of subsequent control breakdown can be greatly simplified.

Fourth Event.—Average chart show persistent trends (up and/or down) over relatively long periods. Range values in this case are seldom related to these trends, except that at the change in direction of a trend the Ranges are generally high.

Cause.—Change in materials or operating conditions exerting a gradual but cumulative effect on the test results. For example, a change in coke quality may produce a gradually increasing (or decreasing) Total Carbon content extending over a period of months; so that, starting with results well within the standard

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limits the trend eventually carries the values outside the upper or lower limit.

Significant points about these trends are:—

(*a*) It is extremely difficult to detect these trends of results, even when pronounced and prolonged, by inspection of daily test figures. Yet by plotting the figures on the control chart the trend becomes immediately evident.

(*b*) By the use of the control chart, corrective action can be applied so that the trend is prevented from exceeding the standard limits. That is, early warning is given of an approaching change in quality. In these cases, there is usually little difficulty in correcting the trend, provided it is realised *in time*.

(*c*) It is worth noting that trends may be related for different properties of the same mix. For example, as carbon values gradually drop, the chart for Tensile will show a corresponding rise. Similarly Silicon and Tensile values show a definite correlation. These charts may thus be used to check a suspected correlation between any two properties. The remedy in the case of related trends is to correct the dominant factor, *e.g.*, the control of Carbon where Tensile is moving out of standard.

Fifth Event.—Short period lapses (one or two chart points at a time) occur in Averages or Ranges charts or both, with remaining points well within standard limits.

Cause.—Isolated points outside standard limits may be caused by some quite temporary change in operating conditions or personnel. For example, temporary replacement of a regular cupola charge or weighing operator due to illness or other cause. Similarly a mistake over material to be used. Another cause would be the testing from dilution taps. These isolated failures are thus ultimately due to a temporary breakdown in supervision. Another cause which may be suspected where these occasional outside points occur is inaccuracy in testing technique. This applies more particularly to tensile results, though it may also occur with analysis results. The remedy is to run checks by determining the standard deviation for a set of six bars cast from the same ladle of metal under as identical conditions as possible. In bad cases, the variation on six results for the same material has exceeded the variation for six bars representing different material.

The outstanding conclusion derived from the use of these control charts is that the problem of metallurgical control is rarely a technical one. That is to say, the greater part of the fluctuations which occur are due, not to some baffling metallurgical problem, but simply to a lack of supervision over the materials and labour involved in the process. The real value of this system is that early warning is given of trouble and clues provided as to the points requiring closer supervision.

Finally, acknowledgment is made to the International Meehanite Metal Company, Limited, for permission to publish the results contained in this Paper, and to Mr. E. M. Currie for his support in applying the system described.

CORRESPONDENCE

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

A CUPOLA QUERY

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—May we seek the courtesy of your columns to enquire for readers' comments on the following cupola performance?:—

Cupola lining dia., 27 in.; rate of melting, 45-48 cwts. per hr.; iron to coke ratio, 8:1, and coke bed, 30 to 33 in.

The iron melted had a very high temperature, and was ideal for pouring small thin-walled castings.

The air was fed through four tuyeres, and the tuyere valves were adjusted so that each tuyere received exactly the same amount of air. The air volume measurements were very carefully made, and were accurate within 1½ per cent. The volume of air thus fed was equivalent to some 1.60 lbs. of oxygen per lb. to carbon, and was therefore slightly above the amount required to burn the carbon to CO. There was rarely any appreciable flame at the charging hole, the escaping gases could not be ignited, and their temperature was quite reasonably low. It was unfortunate that temperatures could not be taken. If the air volume was increased there was evidence that the bed was being burned away.

Since disassociation of gases occurs above 1,000 deg. C. it would therefore appear that initial combustion in the cupola produces more CO than CO_2, and that under optimum conditions this CO is burned to CO_2 either before reaching the superheat zone, or immediately after it. In the above case the amount of air fed does not apparently account for the degree of complete combustion obtained. Can any reader give an explanation, please?—Yours, etc.,

H. A. HALLETT

(Metronic Instrument Company, Limited).

196, Grove Lane, Smethwick 40, Staffs.

SOUTH AFRICAN REMINISCENCES

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I was very interested in reading your article on foundry work at Cape Town in the March 16 issue. There have obviously been many changes in this direction since my father, the late Mr. C. F. Barker, worked there. You may be interested to know that when he was there in 1888-91 he made the first locomotive cylinder ever to be made in Africa. Previous to this, of course, they were imported from England.

He worked there as a journeyman moulder under a Government contract for three years, and instead of renewing it he came to Coventry and started the foundry at the Coventry Ordnance Works. In 1912 he set up in business on his own account at the present premises. I thought some of your African readers might be interested to know these facts.—Yours, etc.,

E. C. BARKER.

C. F. Barker & Sons (Bronze Foundry), Limited,
Newdigate Road, Coventry.
March 20, 1944.

EDUCATION OF THE FOUNDRY WORKER*

What can the foundry industry offer to youth?

By DOUGLAS JEPSON, M.Sc.

[ABRIDGED]

The Education Bill, which very recently passed its second reading, makes it compulsory for children to attend school until the age of 15 and, later, the school-leaving age is to be raised to 16. First there is to be a common Primary Education up to the age of 11 or 12. Then children will proceed, according to their abilities, either to Grammar Schools for education leading to the Universities, or to Modern Schools for a general education, or to Technical Schools for education in technical and craft subjects in addition to a general education. From the Modern and Technical Schools, youths will start work, and will be given further education on one day per week minimum, which the author believes is quite inadequate.

Scientific institutions, among numerous other bodies, have considered, and continue to consider, the effects of the "new deal" in their own spheres, and are planning its detailed application. The Institute is no exception, as is evidenced by the work of the Education Committee resulting in the recently issued "Report and Recommendations on the Education and Workshop Training of Young Foundrymen." It is assumed that this Report has been studied, and it is proposed to review the subject from a different angle.

Home Environment

Children are complex creations, individually responsive to mental as well as to physical stimuli. Every individual differs and responds differently either in degree or in kind to the same treatment. Thus it is that inherently there is no such thing as a common level from which every child might start. It simply does not exist. A standard treatment, common to all, does not lessen, but accentuates, the differences between child and child, so that the capability, outlook, behaviour, and character generally differ ever more widely. Hence the justified outcry against rigid all-embracing school curricula, excessively large classes, and so on. Hence also the advantages, within limits, of private tuition. Now this treatment is not confined to professional educational establishments. The first educational establishment is the home, and conditions there vary widely from malicious ill-treatment, through all stages of unwise to wise control, and then, beyond, to over-indulgence. Add to this the possible disturbance to the child mind of an unhappy home atmosphere as compared with the serenity of life in a contented household. Add the physical effects of type of feeding, from definite under-nourishment, through inadequate to well-balanced diet, and again, beyond, to unwise over-feeding. Add again the variation in time and energy a child may be called upon to spend on home duties.

Fundamentally, home duties are truly educative, and as such, strongly to be recommended, but if carried to excess become an unfair burden on the growing child. Now add the profoundly different effects of the discouragement of, apathetic indifference to, and encouragement of, the child by its parents. It becomes abundantly clear that even if every child were born with exactly the same innate qualities and physique, the home influence alone would make each one different from every other before education in a professional educational establishment even began.

Primary School Life

In the school an attempt is made to counteract bad home circumstances and ill-behaviour, and, despite the common syllabus, to encourage and advance the backward child. Given sufficiently small classes, much could be done, but a teacher with a class of 50, almost the rule nowadays, can give little special attention to those needing it. Segregating children of like age into classes according to their ability has advantages, if it could be done sufficiently fully, but dividing them into two or three sections has a particularly bad psychological effect on children who, being slow in development, or in ill-health, may be placed among the mentally incapable. The consequence to-day is that those unable to advance, decline, and differences between child and child become more marked, not only in scholastic attainment, but in outlook and mental balance, often affected, psychologically, by failing, more or less, where others succeed.

During recent years it has become recognised that the first essential to the growing child is physical well-being. What the home cannot, or will not, provide to this end, the Ministry of Health, in conjunction with the Board of Education, has attempted to do at school, to an increasing extent, in the way of providing free or cheap milk and dinners, cod-liver oil, orange juice and even vitamin tablets. The results have undoubtedly been very beneficial to the under-nourished in every way. One drawback, however, is that the time spent in the education of all has been seriously curtailed, and it is said, with justification, that the raising of the school-leaving age to 15 will do no more than compensate for this time loss. Nevertheless, physical fitness remains as an essential aim, and as a necessary prelude to, and accompaniment of, the development of the mind. This must be remembered when considering post-employment education.

Entry into Industry

When the youth enters the foundry, he is in the middle of the crucial adolescent period. He is developing fast in body, whatever his development of mind may be. The demand for an ample balanced diet is certainly no less than when he was a child.

* A Paper presented to the West Riding Branch of the Institute of British Foundrymen, Mr. L. Turner presiding.

Education of the Foundry Worker

Is it too much to ask that his employers adopt the role carried out previously by the school, and, in conjunction with the Ministry of Labour, continue to ensure that supplies of appropriate nutritive foods be made to supplement his home diet? A start has been made in some factories by the provision of vitaminised cocoa. A personal view, to put it in its meanest light, it is straight business and plain commercial horse-sense, for the healthy, wisely fed, boy will obviously work harder and more efficiently than his under-nourished prototype. But an appeal is made not to this ulterior attitude, but to the moral sensibility of the foundry management. Here is a youth who has been started on the road of life with a healthy, growing body. Help him, for his own sake, to develop it fully. If a shop is badly ventilated, do not stifle conscience by thinking of others which may be worse. Ventilate it well, instead. Give the lad as fresh an air to breathe as you can possibly devise. There is a moral obligation to do so; otherwise growth is stunted and health undermined. Foundry managements must see the youth entering their employment as a living, developing baton in a relay race. The home has handed on the baton to the school, and now the school hands it on to the trade.

Industrial Needs

Let it be realised, then, that just as the prospective educational reforms will, if carried out, be revolutionary in their benefits to the youth of the country, so the foundry trade must revolutionise itself to the same end. It is inevitable that youths of all shades of ability and characteristics will emerge. Now from this collection of youths, a number is required by the trade for foundry work. Which youths? In common with other bodies, the foundry trade specifies "boys and youths of a suitable type." Now what exactly is this "suitable type?" The Institute's Education Committee does not seem to have detailed the specification. Obviously he should be an alert, eager, responsive, honest, diligent youth who can be relied upon to give of his best without undue supervision. In short, it is *moral characteristics* which form the fundamental basis of this suitable boy. Still with the hands, agility of the brain may be necessary, but the utmost manual dexterity or the most brilliant mind will not make a morally weak youth into a suitable one. It is on the rock of moral strength allied with good health that it is possible to build up an appropriate education, scholastic and practical, with certainty that the results will be beneficial to the individual, to the trade, to the community as a whole. Without it, the educational edifice, lofty as it might be, is liable to bring no lasting benefit to anyone, and might well prove to be a disaster.

The foundry management must, therefore, accept, foster, and develop these moral virtues, and show, by its own sincerity, honesty, and generous treatment that they do indeed form the basis of its company's policy. This is meant literally, knowing full well that the basis of the policy of some firms is out and out financial gain, and that honesty is the best policy only in so far as this is achieved. If the educational reforms really educate the youth of this country, this miserable motive will be recognised for what little worth it is, as compared with the profit of a full, unselfish, co-operative life lived by all for all. Is the foundry trade free from this taint? If not, will it reform? It can. It must.

Planned Progressive Work

Now before the foundry trade can amplify the characteristics of the type of boy required, it must specify the job he is desired to perform. In other words, the jobs must be analysed to determine as precisely as may be possible what experience is necessary, what skill, what mental and physical development, and what scholastic attainment those in the industry who are familiar with all the details need to prepare such specifications and present them to the educationalists who have brought the boys to their pre-employment stage. Or rather present them to the careers masters, experts in individual psychology, who will combine with the teachers in discovering the potential foundry workers.

Having discovered the truly suitable boys, what has the foundry trade to offer? Is the foundry trade a suitable type of employment for this suitable type of boy? It must offer what the good boy has been taught to want. And what is that? It is assumed that the essential moral characteristics have been inculcated by the home, and have been developed and supplemented by the school. It is also assumed that the employer is prepared to offer the same regard, as exemplified in one essential way by a "square deal." The boy has been taught to read, to write, to manipulate figures. He has learned the nature of the earth and its history, and the nature and history of the inhabitants of the earth. He has learned of the arts and crafts and sciences man has developed. In particular he has learned how man may be developed into a being of the highest spiritual, mental, and physical qualities, and may employ his talents to the benefit of all. He is awake to the wonders of the world, and to the glorious opportunities for adventures of the body and mind. He wants adventure; he wants to see the world; he wants to do something worth while. He wants scope. In all probability he has no definite ideas on the particular job or career he would like to take up. He knows he wants money to live on, and he would like a fair amount of it so as to be able to afford to do and see the things of which he has learned and read. Money, however, is not his real goal. He wants to be respected. He wants to respect himself.

What can the foundry industry offer? Educationalists will want to know. They will help. They will first of all teach him English to help him to express himself clearly. They know that the poor command of English and the inability to make clear logical statements form one of the main stumbling blocks to evening students at the present time. They will advance the groundwork in mathematics, physics, chemistry and metallurgy and introduce him to engineering drawing. They will reveal something of the fascinating study of metals and alloys. They will tell of the craftsmen of bygone ages, and interest him in

the crafts of to-day. They will inform him of the revolution in scientific thought and accomplishments of recent years. At the same time, they will not belittle manual skill, but, on the contrary, will show him that a combination of practical skill and theoretical knowledge is the ideal combination at which he must aim. They will inform him of the qualifications he might attain per the City and Guilds of London Institute, and the National Certificates, and will guide his studies accordingly. All this they will do in conjunction with the foundry industry, exerting no pressure, but arousing and fostering his interest in the remaining art and growing science of foundry work. In this last respect they will have little difficulty, for probably the most outstanding characteristic of foundry work is its absorbing interest. Preparations for moulding, moulding and core making, making up the charge, melting and casting, analysing and testing, all are interesting in themselves and collectively an adventure. Add the element of uncertainty and the satisfaction of achievement, the arousing of the creative instinct, and, what is more, its gratification.

The boy does his share. He has not long to wait for results, for they come often. He is making something. As his knowledge advances, his interest increases. Here are adventures of the mind. Why has the casting come out like this? Why like that? Why this one perfect? Why that one scrap? Here is mystery. Here is wonder. Here is discovery. Here is success.

Future Requirements

This picture the teacher can show. This instruction he can give. Let him give it in the daytime in working hours. Allow him his fair share of time—half the week—to do it in. He knows from experience that some young boys find half a day or two half-days a week too attractive as "time off," and behave accordingly. The change from work is too short and they do not generally settle down to it. Very probably the change does them good, but not very much in the way of advancing their scholastic education. The reaction would be very different if the time were considerably lengthened. Three days per week for one year would be far more beneficial than one day per week for three years. Cut out most of, if not all, the evening classes. The boy is tired after a hard day's work, and the strain is really more than he should be asked to sustain. Moreover, the teacher is not so fresh as he might be. At the same time, evening classes do find the boys with determination, courage, and perseverance, and it is encouraging to the teacher to see these qualities displayed. Such boys are by far the best to teach. They are keenly interested, anxious to learn, and appreciative of what is done for them. If evening classes did become a thing of the past, the author would sincerely regret the passing of the demonstration of this spirit.

The practical training should take place in the foundry or in institutions established or assisted by the trade. The youth must be introduced to the various branches of the work and get a general appreciation of the activities in all departments. By spending sufficient time in each he will appreciate their correlation and interdependence, so that his eventual co-operation with all colleagues will be the natural and obvious thing to do. Later, he will concentrate on the department for which he is most fitted and of his own choice. Coincident with that, his scholastic studies will turn to that particular field, with the appropriate qualification in view. A corresponding practical examination providing a corresponding qualification, run on national lines, should be organised so that both theoretical and practical aspects of his job would be equally recognised. Then the possession of both qualifications should far outweigh the merit of possessing either the one or the other.

A Programme of Visits

His experience should not be confined to the works in which he is employed. At frequent intervals, visits to other works should be organised, arrangements for mutual exchange of visits being made. There is no necessity to confine the visits to foundries, although such visits would naturally take precedence. They would enhance the boy's interest and broaden his mind. Films of operations in distant works, both in this country and abroad, particularly the colonies and America, should also be shown as a regular feature of the training, as an alternative to actual visits.

Returning to the matter of visits in person, however, the author would recommend that an exchange system be developed between foundries in the English-speaking countries, whereby a qualified moulder, core-maker, pattern-maker, etc., would be given the opportunity, on the basis of character and skill, to spend several months at work in a corresponding foundry abroad, while his counterpart took his place here. Just as local visits would result in a friendly exchange of methods and ideas, and promote unity of purpose in our own foundry to its great benefit, so the inter-country visits would promote friendly understanding, co-operation to the benefit of the countries concerned and ultimately to mankind as a whole.

The boy's practical training should be just as much under specially trained men as his scholastic instruction. Neither practical ability alone, on the one hand, nor academic qualification on the other, automatically includes the ability to teach others. The combination of all three virtues is a rare occurrence, and not to be expected. High moral qualifications are of first importance, as is a sincere, deep-rooted, desire to help the young along the road of life. Patience, the gift of lucid explanation, and a knowledge of psychology, must also be included with the necessary ability or knowledge. The practical instructor's job must be his paramount one, if not his sole one, as is that of the professional teacher. The two must combine, not only to keep their respective courses dovetailing together, but to complete the supervision of their joint charges, in whom they have an equal interest. Of this sincere personal interest, the youth must be fully conscious. He will respond.

Throughout his life he has been taught that the object of education is to lead to a fuller, happier life. He has been given a broad, sound foundation, with

Education of the Foundry Worker

high moral character as the base on which a general scholastic and practical education has been laid. Only after his particular aptitude and special interest have been determined, by consideration of his progress, by observation throughout his school life, and by interviews with psychological experts, has specialisation followed. He is specialising on foundry work. He is the suitable type of boy. This is the next phase in his education, and it also must have as its object to lead him to a happier fuller life. The trade, if it is wise, will accept the object wholeheartedly. It will sustain and develop the interest in foundry work already roused in him. It will ensure that the conditions of employment are beyond reproach, that his job is as secure as possible, that advancement is there to be gained without fear or favour. The very complexity of the human being makes him capable of accomplishments far beyond anything calculable from assessment of his apparent physical and mental powers. In their truly educated, happy workers the chief assets of the foundry trade lie.

Science is revolutionising ways of life. The proposed educational reforms, if carried out, will revolutionise the outlook of the rising generation. Is the industry big enough to see it all through? Or will mean-spirited, self-seeking evil men quench the ardent spirits of the reformers? It is in industry's power to succeed. The difficulties of housing staffing and furnishing are enormous, but can be overcome. If success is achieved "a loftier race than e'er the world hath known shall rise," and prominent among them will be the loftier race of foundry workers.

DISCUSSION

MR. H. FORREST said the youth who had been working hard all day could not have his mind fully alive on the studies of the evening, especially taking into account home-work as well. He was puzzled as to how the boy of, say, 12 to 15 was likely to know sufficiently his most suitable occupation in life to give any lead as to whether his coming technical training should be in an engineering shop, or textile mill or something else. Was there not a risk, for instance, of boys being put to a course of engineering or foundry work and then discovering that they really ought to have taken up textile designing? He thought that the nearer we could get to everybody's work becoming his main hobby the better the work would be done. Mr. Forrest thought that the idea of inter-country exchanges of students was a very fine idea. We in this country could not claim to be pre-eminently a foundry nation as compared with, say, America, where there were better opportunities for study at first hand in the works, and he regarded the idea of inter-country visits as an excellent and valuable one. He himself had had some opportunity of seeing foundries in other countries and he had benefited from that opportunity very definitely.

The Industrial Psychologist

MR. JEPSON, replying, said he agreed that it was far from sure that a boy at an early age would select the career for which he was best fitted, and one of the present troubles was that there were a good many square pegs in round holes. That was why he supported the idea of careers masters in schools. The Institute of Industrial Psychology could do very valuable service by arrangement of tests and investigation to ascertain fundamentally what a boy's possibilities were. There should be competent people in greater number to undertake the job of determining the proper sphere of a child's future work. He wished this psychological study could be applied more fully than was done at present.

MR. FORREST asked whether the psychologist understood what was wanted in the foundry and in the engineering industry. There was a need for brain as well as muscle. There was much in the co-ordination of hand and eye, but that was not all. Boys, before they enter the technical school, should have an opportunity to visit works of various kinds, including foundries, to give them the chance to determine for themselves what sort of job they would like, before they entered on a course of technical education committing them to their future job.

MR. J. TIMBRELL said in many cases boys had drifted into some phase of work for which they were not best suited. There ought to be some vocational guidance and there was great scope for the development of industrial psychologists.

MR. JEPSON said he spent a couple of years going round works and analysing the various jobs by means of a scheme embodying a number of fundamental psychological attributes on which a job could be arbitrarily assessed. The assessment was not precise, but the results were of definite value, and it was a development along those lines that he had in mind in the pursuance of psychological tests.

MR. JEPSON, replying to questions raised by Mr. Nichol, said personal experience had shown that the proportion of students wishing to specialise in foundry practice had up to date been small. If the demand were there the equipment would be forthcoming. It was a question of which is to come first—the facilities for foundry students or the foundry students to justify the facilities.

MR. FORREST said he believed some few centres like Birmingham and Sheffield had better facilities for foundry instruction than most others. He was sure the institution of facilities elsewhere would work out well wherever foundry industry was on a scale big enough to justify the establishment of such facilities in the local or area technical school. Where there were only very few students it would be difficult. It might be possible to teach them to mould, etc., but unless they had a cupola, the teaching would not really have very much relation to the real job in a practical sense—under such limitations the young men would not get a wide enough training, and the student might have to go somewhere else to get it.

MR. J. BLAKISTON said after the war there would

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Education of the Foundry Worker

be hundreds of millions of pounds worth of equipment and plant of all kinds available, and he suggested it was up to the educational authorities to fight for a share, to help them modernise their schools and colleges, and to bring them nearer up-to-date, according to the developments of modern industry. Scientific apparatus as used in modern industry was becoming every day more complicated, and the gap between it and the obsolete equipment in many technical schools was getting steadily wider.

MR. G. BURGESS said as one interested in foundry life he had the misfortune to be borne in a textile town. If it had been possible for him to see inside a foundry at the age of 14 or 15 he would have had no hesitation in entering the foundry industry. Not a word had been mentioned at school about the foundry industry, and it was pure accident that eventually he entered it.

MR. C. S. JOHNSON, a young member, said he, on the contrary, had had the good fortune to see round a foundry as a boy, and he had every reason to be thankful for that opportunity, which showed him the job for his future. If full-scale classes in foundry work could not be arranged at all local technical colleges, would it not be possible, he wondered, to have an arrangement for some practical work in a local foundry?

MR. W. JONES, another young member, said he had had great difficulty in trying to get a course which would fit the needs of the City and Guilds of London Institute examination. There was a great need for more classes in foundry practice for anybody interested, not merely as a metallurgist but in actual direct foundry practice.

MR. JEPSON said that classes could be arranged, but the number of students applying for them had totalled only six in the past three or four years.

A member from Halifax said that in that town they were very fortunate in the fact that though equipment at the local college was limited, the students were able to have certain practical facilities at a works in the district, thanks to the enthusiastic help of Mr. Blakiston and Mr. Nichols, and the kindly co-operation of the directors and management of a local firm.

MR. JEPSON said that was very interesting, and he asked whether the students came first or the facilities.

MR. BLAKISTON said, knowing that there were not the facilities desired, he arranged for them, and that provided the students. The firms in the district were circularised and they were enabled to start with ten to fourteen students. The number had decreased slightly owing to war calls, but the authorities were carrying on and hoped to maintain the classes.

MR. H. BALME said Mr. Jepson had shown them not only a way of education, but a way of life. He (Mr. Balme) had endeavoured to teach foundry students for the City and Guilds examinations, not without success. Huddersfield had no equipment, but

(*Concluded in next column*).

(*Concluded from previous column.*)

it had keen classes. The students were in the industry and received practical training at their place of employment which, after all, was the proper place for it. He fully agreed that it was desirable to eliminate night classes as soon as these could be substituted by daytime studies. It was the duty of the industry to help in educating their own apprentices by giving facilities for them to receive instruction at a time when they were in a fit condition to assimilate it.

Hearty thanks were voiced to Mr. Jepson for his Paper, on the motion of Mr. H. Forrest, seconded by Mr. J. Blakiston.

IRON AND STEEL RESEARCH

FORMATION OF NEW ASSOCIATION

At their meeting on March 21, the Council of the British Iron and Steel Federation approved a scheme which had been prepared by a Committee set up by Sir James Lithgow, Bt., M.C. (the outgoing president, who was chairman of the Committee in question), for the formation of the British Iron and Steel Research Association, which will take over the work of the Iron and Steel Industrial Research Council. The constitution of the new Research Association provides for collaboration with the Iron and Steel Institute, with the right of nomination of members of the Council of the new Association. It is understood that these will be scientists not connected with the industry, but engaged in fields of work related to the work of the Association. The Federation will nominate members who will represent the different departments of the industry—scientific, technological and management.

The present Research Council developed out of a Fuel Economy Committee established in 1924, and has now become one of the largest and leading collective research organisations in the country. Heretofore it has been a Standing Committee of the Federation, but a report on the work of the Research Council by the Department of Scientific and Industrial Research (October, 1942), which bore high testimony both to the scope and to the quality of the work which had been carried out under the direction of the Council, also recommended that it had now reached a stage where it was desirable that its work should be transferred to an autonomous research association under the ægis of the Federation and financed by it, to ensure that research becomes an activity of the whole industry and not merely a service rendered to it.

The scheme adopted provides for an annual expenditure of any amount which the Council of the Research Association may find necessary for the work required. Authority has been given to the Association to expend in the first instance up to £250,000 annually without further reference for the approval of the Federation. In the meantime, the Iron and Steel Industrial Research Council is continuing to direct the large range of research which it has in progress.

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Misc 1

NEWS IN BRIEF

COX & DANKS, LIMITED, iron and steel scrap merchants, have opened a new depot at Bromley-by-Bow, London, E.

ROLL TURNING is now being done by women at a Scottish steelworks, and they are reported to be highly efficient. The women not only do the actual turning, but set up the jobs as well.

THE INTERNATIONAL NICKEL COMPANY OF CANADA, LIMITED, reports a net profit for 1943 of $31,127,204 (U.S.) after making provision for all charges, depreciation and taxes. For 1942, the net profit was $33,301,829.

MR. FREDERICK R. SIMMS has presented the Council of the Society of Engineers with a donation of £500 for the annual award of a gold medal for a discovery or outstanding invention, lecture or paper by any grade of member of the Society during any one year in connection with any branch of civil or mechanical engineering.

A CINE-PROJECTOR is required by the Keighley Association of Engineers so that the council of the Association may have greater scope when arranging future lectures. An appeal is made to members to contribute towards the cost of the equipment. Donations should be sent to the hon. treasurer, Mr. R. Shackleton, "Ashbourne," Kenya Mount, Blackhill, Keighley.

THE ANNUAL CORPORATE MEETING of the Institution of Chemical Engineers will be held at the Connaught Rooms, Great Queen Street, London, W.C.2, on Friday, April 14, at 11 a.m. The president, Mr. F. A. Greene, will give his address at 12 noon, his subject being "Our Title—a Reminder." Luncheon will be served at 1 p.m., and at 3 p.m. the first J. Arthur Reavell Lecture will be delivered by Mr. J. G. Bennett on "Coal and the Chemical Industry."

PRINCIPAL GEORGE THOMPSON, of Swansea Technical College, speaking recently on the new Education Bill, said that it was "delightfully vague" in its provisions regarding technical education. It was felt that certain selected colleges should be raised in status to that of a technical university. That was not running counter to the university college, but parallel. The function of a university was to provide a liberal education in arts and science with facilities for pure research. That of the technical college was to provide specialised education in crafts, science, etc., and they pleaded for facilities for research in industrial processes.

THE ANNUAL GENERAL MEETING of the London Local Section of the Institute of Metals will be held at the Junior Institution of Engineers (Incorporated), 39, Victoria Street, London, S.W.1, at 6.30 p.m., on April 13. The meeting will be followed by a Paper by Dr. Bernard P. Dudding, M.B.E., B.Sc., and Mr. W. J. Jennett, B.Sc. (Eng.), on "Quality Control with Particular Reference to Metallurgical Inspection." At a meeting of the London Section on May 11, a Paper on "Modern Metal Working Equipment" will be given by Mr. C. E. Davies, M.I.Mech.E., and Dr. L. R. Underwood, M.I.Mech.E.

BRITISH IRON AND STEEL FEDERATION

Mr. A. C. Macdiarmid, chairman and general managing director of Stewarts and Lloyds, Limited, and a vice-president of the British Employers' Confederation, was last week unanimously elected president of the British Iron and Steel Federation. He succeeds Sir James Lithgow, Bt., who has been president of the Federation since February, 1942.

Mr. Macdiarmid joined Stewarts and Lloyds, Limited, in 1909 as secretary, becoming a director in 1918 and chairman and managing director in 1926. He took a leading part in the reorganisation and development of the British iron and steel industry and the steel tube industry in the years between the two wars. Under his chairmanship, Stewarts and Lloyds, Limited, developed their undertaking at Corby, in Northamptonshire, designed to make use of the national resources of iron ore as an alternative to imported raw material for the supply of basic-Bessemer steel for the company's new steel plant and tube works erected on the same site. Mr. Macdiarmid is also on the boards of Richard Thomas & Company, Limited; Stanton Ironworks Company, Limited (chairman); Tube Investments, Limited; United Steel Companies, Limited; United Tube Holdings, Limited (chairman); Islip Iron Company, Limited; and New Crown Forgings, Limited (chairman).

SCRAP SUPPLIES IN THE NORTH-EAST

Mr. H. Secker, Director of Scrap Supplies, addressing the annual meeting of the North-East Association of Iron, Steel and Metal Merchants at Middlesbrough, suggested that they should adopt as their slogan for the current year, "keep scrap moving."

Last year, he said, had been a record year for scrap metal consumption, but special collections of scrap were nearing their end, and merchants would need to put forward a special effort to maintain steel production at its present level. Tees-side was probably the most important steel-producing area in the country, but it was also "a deficiency area" in regard to scrap supplies, and whilst the Control by special arrangements had hitherto been able to maintain deliveries, Tees-side might have to depend on its own scrap resources.

At the business meeting which followed, Mr. H. Turner (Stockton) was elected president, and Mr. F. Dukes (Thornaby) vice-president.

A TOTAL OF 26,760,000 steel castings was produced in America during the last quarter of 1943, according to the War Production Board Steel Division. This conclusion was arrived at by taking the total weight of all castings fabricated during the quarter—669,000 short tons—and dividing by 50 lbs., the estimated average weight of steel castings. Production of castings by weight in short tons over the past three years was as follows:—1941, 1,577,736 tons; 1942, 2,239,693 tons; and 1943, 2,742,604 tons.

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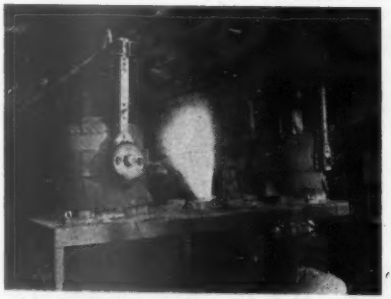

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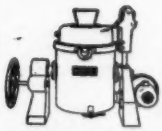

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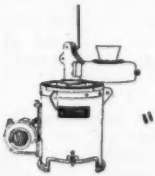

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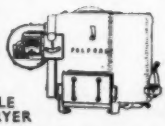

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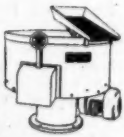

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COMPANY RESULTS

(Figures for previous year in brackets)

Lightalloys—Interim dividend of 12½% (same).

Blakey's Boot Protectors—Dividend of 7½% (same).

Range Boilers—Final dividend on the ordinary shares of 15%, making 20%.

Amalgamated Metal Corporation—Ordinary dividend of 3½% for the year ending March 31.

Brown Bayley's Steel Works—Interim dividend on the ordinary capital of 5%, tax free (same).

Glover & Main—Final dividend of 10% (8½%) and a bonus of 7½% (same), making 22½% (20%).

Swan, Hunter & Wigham Richardson—Net profit for 1943, £368,744 (£398,018); final dividend of 8% (6%), making 12% (10%).

Lancashire Dynamo & Crypto—Net profit for 1943, £127,000 (£122,020); final dividend of 10%, plus a bonus of 7½%, making 22½% (same).

Anti-Attrition Metal—Net profit for the year to July 31 last, £12,562 (£5,030); dividend of 15% (5%), £13,125 (£4,375); forward, £2,621 (£2,584).

Electrolytic Zinc Company of Australasia—Dividend of 4% (same) on the preference and ordinary shares for the half-year ended December 31, 1943.

G. D. Peters & Company—Net profit for 1943, £63,575 (£54,832); final dividend of 7½% (same), plus a cash bonus of 2½% (nil), making 17½% (15%).

Royles—Net profit for 1943, £16,622 (£11,161); final dividend of 10% (9%), making 13% (12%), and a bonus of 3%, payable out of investment income; forward, £37,270 (£32,957).

Benton & Stone—Profit to July 31, 1943, £70,320 (£78,020); taxation, £57,038; preference dividend, £3,405; ordinary dividend of 15%, free of tax; forward, £22,796 (£20,419).

Ingall, Parsons, Clive & Company—Net profit to September 30 last, £8,763 (£9,389); to war contingency reserve, £4,000; dividend of 10% (6%) on the ordinary and deferred shares; forward, £22,524 (£13,760).

Sanbra—Net profit for 1943, £9,506 (£15,200); preference dividend, £1,800; final ordinary dividend of 5% and a cash bonus of 2½%, making 12½% (same), (£4,062 net); to general reserve, £5,000; forward, £2,975 (£4,331).

Vickers—Net profit for 1943, after providing for taxation, £984,119 (£962,600); transferred to contingencies, £250,000 (£250,000); final ordinary dividend of 6% (same), making 10% (same); forward, £897,627 (£783,447).

Federated Foundries—Net profit for 1943, £37,937 (£42,386); additional depreciation reserve, £5,000 (£15,000); two years' arrears on the 5% preference shares, taking payments to the end of 1943; forward, £34,917 (£17,590).

Arnott & Harrison—Net profit to June 30 last, £19,225 (£14,154); future tax and contingencies reserve, £1,000 (nil); to general reserve, £6,000 (£4,000); dividend of 9.6d. (9d.) per share, or 20% (18¾%); forward, £10,316 (£8,591).

British Aluminium Company—Profit for 1943, after providing for E.P.T., £1,068,937 (£1,051,120); depreciation, £75,000 (£50,000); to reserve, £125,000 (£150,000); final ordinary dividend of 7% (same), making 10% (same); forward, £274,684.

Clayton Dewandre—Profit for 1943, after providing for taxation, £42,322 (£39,127); general reserve, £7,500 (same); specially written off patents and development account, £6,552 (nil); final dividend of 6%, making 10% (same); forward, £14,552 (£13,582).

Midland Electric Manufacturing—Net profit for 1943, £46,394 (£44,606); dividend on the preference shares, £2,812; dividend of 10% on the ordinary shares, £7,500; bonus of 15% on the ordinary shares, £11,250; to general reserve, £20,000; forward, £28,960.

P. & W. Maclellan—Net profit, after provision for tax and contingencies, £55,060 (£42,190); debenture interest, £6,561; depreciation, £10,000 (£7,500); deferred repairs, £8,000 (£3,000); to reserve, £10,000 (£5,000); ordinary dividend of 6% (same); forward, £8,054 (£8,075).

Beans Industries—Net profit for the year ended November 30 last, after depreciation, obsolescence and taxation, £40,207 (£40,052); to contingencies, £10,000 (£5,000); to general reserve, nil (£10,000); final dividend on the ordinary shares of 27½%, making 37½% (same); forward, £22,683 (£17,109).

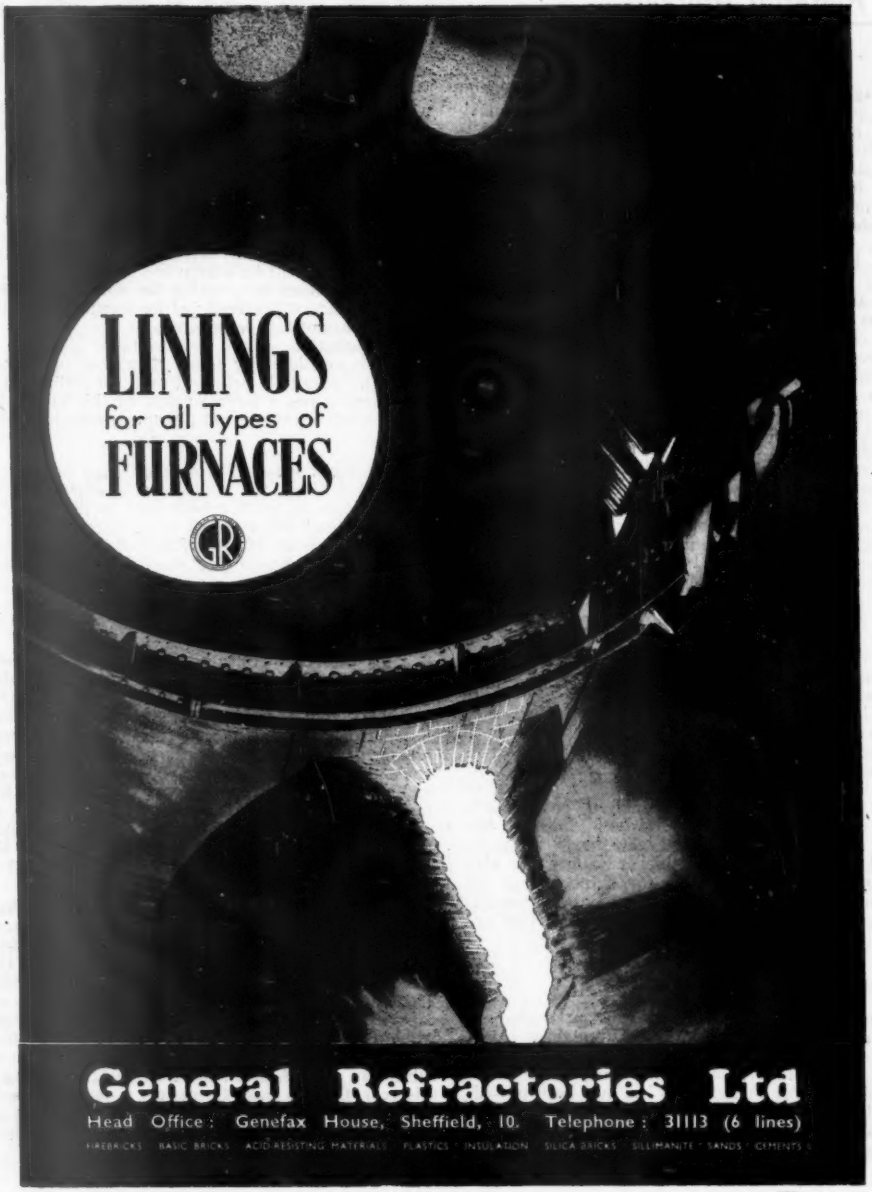
Hoffmann Manufacturing Company—Profit for 1943, after depreciation and taxation, £217,930; debenture interest, £12,221; 7½% cumulative preference dividend, £37,500; ordinary interim dividend, £37,500; general reserve, £50,000; final dividend on the ordinary shares of 10%, free of tax, £50,000; forward, £98,577 (£67,868).

Guest Keen Baldwins Iron & Steel Company—Profit for 1943, £684,141 (£661,043); depreciation, £375,000 (same); debenture interest, £85,041 (£85,855); redemption, £27,459 (£26,403); 5% notes interest, £25,933 (£26,429); redemption, £10,428 (£9,931); net balance, £155,964 (£133,425); dividend on the ordinary shares of 6% (5%); forward, £96,953 (£90,292).

Thos. Firth & John Brown—Trading profit for 1943, £578,853; depreciation, £175,000 (same); debenture and mortgage interest, £47,965 (£48,847); directors' fees, £5,018 (£2,716); net profit, £350,870 (£311,357); ordinary dividend of 10%, tax free, £155,000 (same); preference dividend, £42,000; to contingency reserve, £100,000 (£75,000); war damage contribution, £10,000 (£15,000); forward, £224,417 (£180,547).

Charles Clifford & Son—Net profit for 1943, after charging depreciation, war damage insurance and taxation, £18,539 (£18,460); to reserve for war contingencies, £5,000; preference dividend, less tax, £900; interim dividend on the ordinary shares of 1s. per share, free of tax, £3,000 (same); final dividend of 2s. 6d. per share, free of tax, £7,500 (same); to general reserve, £2,000; forward, £24,930 (£24,791).

National Gas & Oil Engine Company—Profit for 1943, after provision for depreciation, taxation and war damage contribution, and including income from investments of £1,652 and a transfer from contingencies reserve of £20,000, £67,263 (£59,103); goodwill written off, £22,175; dividend on the preference shares, £12,000; ordinary dividend of 5% (same), £30,000; to general reserve, £42,000; forward, £32,544 (£30,456).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Raw Material Markets

IRON AND STEEL

Shortage of fuel and transport has had its effect on pig-iron production, and these difficulties are not likely to grow less in the near future. However, if there be any shrinkage of blast-furnace output, no essential interest will be jeopardised. Considerable reserves of pig-iron have been accumulated, and, subject to transport facilities being available, these will suffice to meet any probable requisitions over the next few months. Licences for high-phosphorus iron are not at the moment being issued quite so freely, but the Control is taking good care of the needs of the general engineering and speciality foundries, many of which are still busy on Government work. A steady demand for refined and low and medium phosphorus iron is maintained. Hematite is issued only for specially authorised purposes. There is not a great deal of good cast-iron scrap on offer, but foundries are not being badly served in the circumstances. The need to economise in transport, of course, applies to scrap as much as pig-iron, and increased allocations cannot normally be booked while preparations for the new offensives are under way.

There is not the slightest indication of any recession of activity in the re-rolling trades. Some establishments are so favourably situated that, if not another order were booked before June next, they would still be assured of full employment. Thus there is a steady call for prime billets and any form of defective material which is suitable for re-rolling. There seems to be no lack of sheet bars, although consumption is now on a very heavy scale.

The impact of reduced demand is most noticeable in the turnover of heavy joists and sections. For light material in the form of bars, flats, squares, tees, etc., the demand is still brisk, although waiting periods in this branch of the industry are not quite so long as they were. For steel plates, on the other hand, the pressure is phenomenal, and allocation of outputs, to ensure that no essential work is delayed, continues to call for the most careful supervision. Scarcely less urgent is the call for sheets. Light sheets are more extensively specified, but the thicker gauges are also wanted in substantial tonnages for shipbuilding and engineering purposes. Colliery requirements, of course, are undiminished and quotas for the second period are in the hands of the Ministry of Fuel and Power.

NON-FERROUS METALS

There are no indications of any substantial changes in the non-ferrous metal position. Although war production is likely to be maintained at a high level throughout this year, it now seems fairly certain that the peak demand for these metals has now been passed. This is clearly reflected in the scrap market; copper scrap is still finding a ready outlet, but brass scrap, which was once eagerly taken up, is becoming increasingly difficult to dispose of. Even with the prospect of considerably reduced copper supplies in the near future, there is no likelihood of any shortage for essential needs, and unless there is an alteration in the production programme, it is not likely that consumption will increase to any great extent.

Supplies of tin are strictly controlled, although there is no definite scarcity and adequate amounts are forthcoming to satisfy the requirements of priority undertakings. It is realised that although the time when the tin-bearing territories in south-eastern Asia are liberated may be drawing closer, the recapture of these areas will bring about no immediate increase in tin supplies. Considerable damage is certain to have been done to mining equipment already, and it is improbable that the Japanese will be driven out before they have rendered the mines unworkable for some time. Possibly several years will elapse before anything like the pre-war tin output can be attained.

Consumption of zinc is now fairly stable at a level which is considerably lower than that of a year ago. A small quantity is being released for civilian purposes, but there is not a large surplus of this metal, because imports are adjusted to Government requirements.

AN ESSAY COMPETITION on the design or construction of welded ships for students and others between 18 and 25 years of age has been held by the Institution of Engineers and Shipbuilders in Scotland. The winner of the first prize of £10 is Mr. A. G. Hadjipyrou, a student of the Royal Technical College, Glasgow. A second prize of £7 10s., instituted in view of the excellence of the entries, has been awarded to Mr. C. E. R. King, a draughtsman with Philip & Sons, Limited, Dartmouth.

THE ESTIMATED consumption of iron and steel scrap in the United States in 1943 reached approximately 55,900,000 gross tons according to Mr. E. C. Barringer, president and executive secretary of the Institute of Scrap Iron and Steel, Inc. This total was 4 per cent. greater than the previous peak of 53,807,000 gross tons consumed in 1942. The 55,900,000 tons of scrap was melted in various types of furnaces with 53,856,000 tons of pig-iron to make new steel and castings almost entirely for the war effort, and, therefore, says Mr. Barringer, it may be said that 51 per cent. of all war and civilian iron and steel articles made in 1943 represented scrap.

PIG-IRON PRODUCTION started in the New Year at Utah Government's new $180,000,000 steel plant near Provo, with the blowing in of the first blast furnace. This plant is operated for the Government by Geneva Steel Company, U.S. Steel Corporation subsidiary. There are three blast furnaces erected, each with a daily capacity of 1,100 tons. The iron and steel plant as a whole is the largest in Western America. Construction was begun by Columbia Steel Company, West Coast subsidiary of U.S. Steel, in April, 1942. In August of this year, Geneva Steel Company, a newly-formed U.S. Steel subsidiary, contracted with Defense Plant Corporation to operate this great war plant for the duration without profit or fee.